# Simulation of Normal and Cancerous T-cell Membrane Electroporation

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## Abstract

Electroporation is an increase of the cell membrane permeability due to the formation of aqueous pores in it when the cell is under the influence of an intense electric field [1][2]. The formation of such pores in the membrane can be used to enhance the uptake of chemotherapeutic drugs into the cell in a cancer treatment known as electrochemotherapy [3]. In some cases the direct experimental measurement of the different phenomena associated with membrane electroporation is not possible and the use of numerical simulations becomes necessary. In this paper we simulated normal and cancerous T-cell membrane electroporation using COMSOL Multiphysics® software to solve the set of coupled differential equations that describe electroporation [4][5]. The induced transmembrane voltage (ITV) and the pore formation density were obtained and analyzed (Figures 1-2). Our main results were higher pore formation in the cancerous T-cell, and an asymmetric pore density distribution with slightly larger values present on the hyperpolarized regions of the membrane (Figures 3-4).

## Reference

[1] Andrei G. Pakhomov, Damijan Miklavcic et al., “Advanced Electroporation Techniques in Biology and Medicine”, CRC Press Taylor & Francis Group, Chapter 3, 51-70 (2010).

[2] Stephen T. Kee, Julie Gehl et al., “Clinical Aspects of Electroporation”. Springer Science+Business Media, Chapters 1-6, 3-82 (2011).

[3] Jean Escoffre, Marie-Pierre Rols, “Electrochemotherapy: Progress and Prospects”. Current Pharmaceutical Design, Volume 18, 3406-3415 (2012).

[4] Damijan Miklavcic, Gorazd Pucihar et al., “A Time- Dependent Numerical Model of Transmembrane Voltage Inducement and Electroporation of Irregularly Shaped Cells”, IEEE Transactions on Biomedical Engineering, Volume 51, 1491-1501 (2009).

[5] Katherine A . DeBruin, Wanda Krassowska. “Modeling Electroporation in a Single Cell. II. Effects of Ionic Concentrations”. Biophysical Journal, Volume 77, 1225–1233 (1999).

## Figures used in the abstract

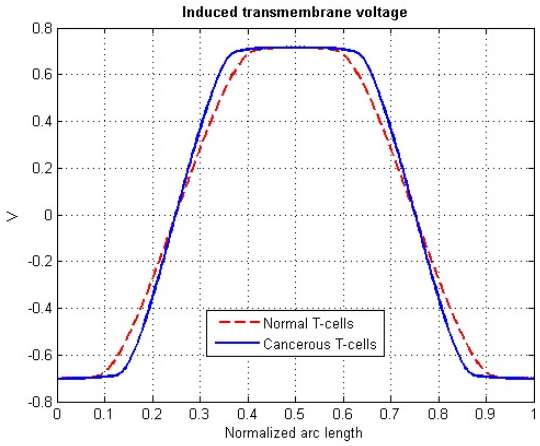


**Figure 1**: ITV in normal and cancerous T-Cells.

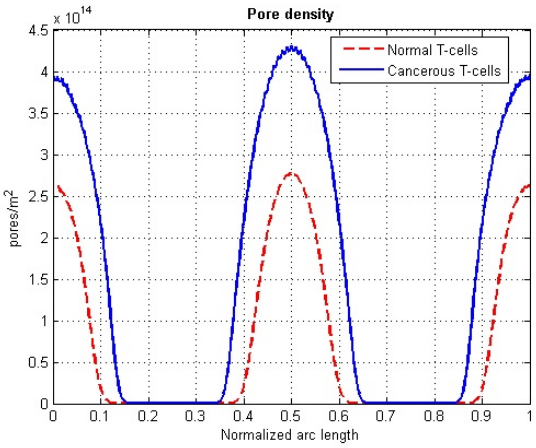


**Figure 2**: Pore density in normal and cancerous T-Cells.

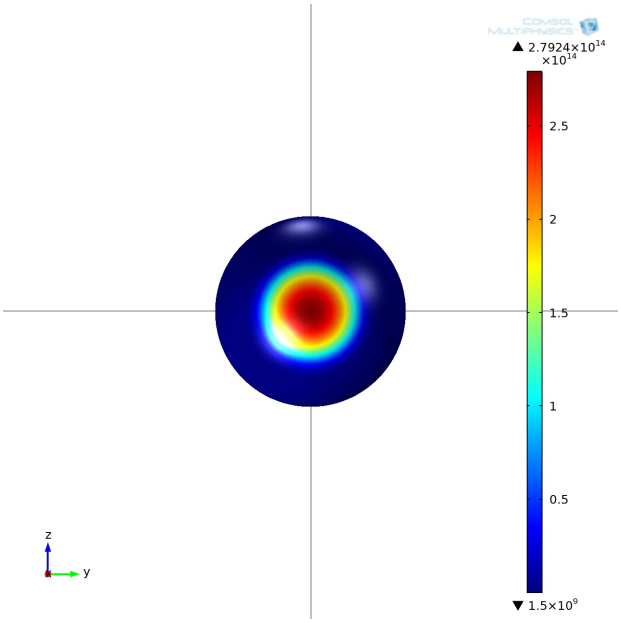


**Figure 3**: Pore density at the hyperpolarized end of the normal T-Cell.

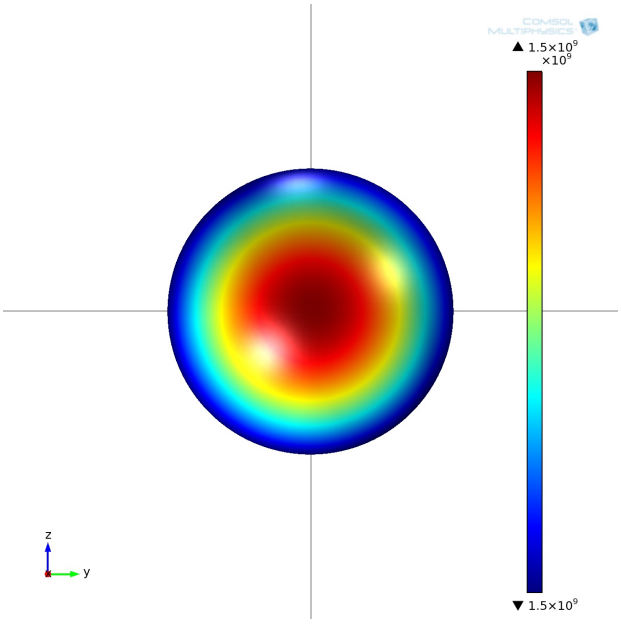


**Figure 4**: Pore density at the hyperpolarized end of the cancerous T-Cell.